

**(19) Korea patent office (KR) Unexamined Patent Publication (A)**

(51) Int.Cl. 6 H04B 1/69

Registration No	KR2002-0052440.
Application No	10-2000-0081713
Application Date	26/12/2000
Publication Date	04/07/2002
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Examination	EopEum
Title of Invention	The channel estimator [Channel Estimate Device Using a Parallel Interference Cancellation] using the parallel interference canceller.

**Abstract**

The present invention relates to direct, the channel estimation in the sequential CDMA (DS CDMA, Direct Sequence Code Division Multiple Access) receiver, particularly, to the channel estimator for inputting the signal from which an interference is removed to the channel estimator by using the parallel interference canceller in order to minimize the channel estimation error.

As to direct, the sequential CDMA receiver, the present invention is the signal in which an interference is removed from the interference canceller of the final stage from the received signal comprised of the channel estimator estimating \*\*\* channel as to the receiver consisting of data correlator despreaded for the reconstitution of data, the quantizer quantizing the signal, the refreshable roofing tile regenerating the received signal, and the interference canceller removing the regenerated signal by the other user from the received signal is a multic-stage. The quantizer quantizing the signal is despread through data correlator.

This the present invention improves the performance of the channel estimator and it reduces amount of the additional noises which is caused by the multic-stage parallel interference canceller and it can improve the performance of a receiver.

**Representative Drawing(s)**

Fig.

**Keyword(s)**

The channel estimator, the multic-stage parallel interference canceller, and the direct sequential CDMA.

**Description**

## □ Brief Explanation of the Drawing(s)

Figure 1 is a block diagram showing the receiver structure of using the conventional parallel interference canceller

Figure 2 is a block diagram showing the receiver structure of using the parallel interference canceller

\*The description of reference numerals of the main elements in drawings\*

10: data correlator 40: interference canceller.

20: quantizer 50: channel estimator.

30: refreshable.

## □ Details of the Invention

### ■ Purpose of the Invention

#### ■ The Technical Field to which the Invention belongs and the Prior Art in that Field

The present invention relates to direct, the channel estimation in the sequential CDMA (DS CDMA, Direct Sequence Code Division Multiple Access) receiver, particularly, to the channel estimator for inputting the signal from which an interference is removed to the channel estimator by using the parallel interference canceller in order to minimize the channel estimation error.

Figure 1 is a block diagram showing the receiver structure of using the conventional parallel interference canceller.

As shown in the figure, it is comprised of the sequential CDMA (DS CDMA) receiver using the multic-stage parallel interference canceller of data correlator (10) despreaded for the reconstitution of data, the quantizer (20) quantizing the signal, the refreshable (30) regenerating the received signal, the interference canceller (40) removing the regenerated signal by the other user, and the channel estimator (50) for the reconstitution of data and received signal refreshable. The quantizer (20) quantizing the signal is despread through data correlator.

Here, by using the channel estimate which data correlator (10) obtains from the channel estimator (50), the signal which is despread to the process of despreaded the signal diffusing in the transmission group in this way restores the carrier signal through the phase unwrapping.

Moreover, the channel estimator (50) uses for the estimation about the important parameter including the channel response, the received power etc. through the de-spreading process.

Generally, in case of the receiver which does not use the interference canceller, it can be comprised as data correlator (10) and channel estimator (50).

However, when the interference canceller (40) is used, the refreshable (30) is with two kinds of to a need.

The quantizer (20) quantizes the signal which is despread through data correlator (10).

And as to the refreshable (30), by using data obtained from data correlator (10) and the channel estimate obtained from the channel estimator (50), it regenerates the received signal of the user inputted to a receiver.

If it illustrates for a refreshable in detail, when the CDMA system to restoring the received signal about one user because of sending and receiving a signal while a plurality of users shares the time and frequency, it acts the signal of the other user on an interference.

That is, by using the refreshable (30) since the received signal of the other users acting on not only the recovered signal about one user but also an interference in data correlator pass of the reception input signal being together restored, the signal of one user is regenerated to the signal of data correlator

pass former, that is, the signal before despread about the signal which is despread after data correlator (10) pass mixed with other users.

And in this way, as long as it is regenerated, since acting in the signal restoration of the other user on an interference, it enters in the received signal reconstitution about the other user to the interference canceller and the signal of a user is removed.

In the CDMA system, it is necessary to have the step that the signal of the other user restores the signal of one user about the signal of one user since acting on an interference and removes the signal of the other user acting on an interference.

By playing the role that it takes out the regenerated signal by the other users as immediately, the interference canceller (30) from the reception input signal to come under above statement step the reception input signal of one user can be obtained.

In this way, as long as an interference by the other user is removed, while going over to the next stage and again repeating the process through data correlator (10), the reception input signal of a user can restore data of the higher with one dimension reliability.

This process is used as one shift of the consecutive multiple division access mode receiver using the multic-stage parallel interference canceller as the structure of a multic-stage in order to improve the performance of a receiver.

Generally, as to the multic-stage parallel interference canceller, because of passing through the course of regenerating a signal from data determined on the front end, it is influenced on the reliability of data of the front end is enormous.

So, many researches for raising the reliability of data decision process of being made in the front end proceeded.

But the multic-stage parallel interference cancellation passes through the course at the same time, of removing the signal of the regenerated multiuser under the environment in which a plurality of users exists. Therefore, in case an error exists in the channel estimate no matter what, even if the reliability of data at the front end is high, at the same time, many noise component acts as the input signal of a receiver.

Moreover, a signal inputted with the channel estimator provides the noise component which the channel estimate which passes through the channel estimator since including many interference signal and it obtains is many like data.

Therefore, when a user grows, the problem that the performance of the channel estimator is gradually lowered is generated.

And as to the channel estimator having the degraded performance as described above, the performance of the receiver which uses the multic-stage parallel interference canceller since adding the controversies which is many in the interference removal step is greatly reduced and the problem of moreover strengthening with the reconstitution about data is generated.

#### ■ The Technical Challenges of the Invention

Thus, the present invention is created in order to improve the problem as described above. In order that it minimizes the channel estimation error in the receiver using the multic-stage parallel interference canceller of the environment in which a plurality of users exists, by using the signal from which an interference is removed, it operates the channel estimator, the signal has the purpose.

#### ■ Structure & Operation of the Invention

As to direct, the sequential CDMA receiver, the present invention is the signal in which an interference is removed from the interference canceller of the final stage from the received signal comprised of the channel estimator estimating \*\*\* channel as to the receiver consisting of data correlator despread

for the reconstitution of data, the quantizer quantizing the signal, the refreshable roofing tile regenerating the received signal, and the interference canceller removing the regenerated signal by the other user from the received signal is a multi-stage. The quantizer quantizing the signal is despread through data correlator.

That is, by channel-estimating by using the signal which passes through the interference canceller of the final stage in the different manner as channel-estimating by using the signal in which the channel estimator at the receiver structure of being general is received the form in which the multi-user interference noise added in the channel estimate is removed is become with the withdrawal crab.

Figure 2 is a block diagram showing the receiver structure of using the parallel interference canceller. As shown in the figure, it is comprised of data correlator (10) despread the signal diffusing in the transmission group, the quantizer (20) quantizing the signal, the refreshable (30) regenerating the received signal of the user inputted to a receiver, the interference canceller (40) removing the regenerated signal by the other user from the received signal, and the channel estimator (50). The quantizer (20) quantizing the signal is despread. As to the channel estimator (50), the output of the interference canceller of the final stage is input and estimating a channel.

Here, data correlator (10) is the process of despread the signal diffusing in the transmission group.

By using the channel estimate which the signal which is despread as described above obtains from the channel estimator (50), it restores the carrier signal through the phase unwrapping.

The quantizer (20) quantizes the signal which is despread through data correlator (10).

Moreover, as to the refreshable (30), by using data obtained from data correlator (10) and the channel estimate obtained from the channel estimator (50), it regenerates the received signal of the user inputted to a receiver.

As to the CDMA system, when to restoring the received signal about one user because of sending and receiving a signal while a plurality of users shares the time and frequency, it acts the signal of the other user on an interference.

That is, by using the refreshable (30) since the received signal of the other users acting on not only the recovered signal about one user but also an interference in data correlator pass of the reception input signal being together restored, the signal of one user is regenerated to the signal of data correlator (10) pass former, that is, the signal before despread about the signal which is despread after data correlator (10) pass mixed with other users.

And in this way, as long as it is regenerated, since acting in the signal restoration of the other user on an interference, it enters in the received signal reconstitution about the other user to the interference canceller and the signal of a user is removed.

In the received signal, the interference canceller (40) removes the regenerated signal by the other users and it avoids the performance degradation from the interference signal which a user suffers.

And as long as the interference canceller (40) is passed through, while going over to the next stage and again repeating the process through data correlator (10), the reception input signal of a user can restore data of the higher with one dimension reliability.

At this time, the signal passing through the interference canceller of the final stage is input to the present invention to the channel estimator in the different manner as channel-estimating by using the signal in which the channel estimator at the receiver structure of being general is received.

And then, as to the channel estimator, by channel-estimating by using the signal from which the interference signal by the other users is to some extent removed it decreases the noise added in the channel estimate, it can do the exact reconstitution.

It is the same as that of the next time if fig. 2 is illustrated in detail.

The received signal transmitted through the transmission group of the DS CDMA is input to data correlator (10).

At this time, it can be said to be the received signal of M number user 2, and the received signal of the third user 1, and the received signal of the second user the received signal of the first user M with 3 when the number of users can be said to be M life.

And then, in the received signal of the first user, the received signal is altogether added to the signal of M number user and the signal is inputted to the form like  $1+2+3+...+M$  at a time.

Firstly, it looks into in the position of the received signal of the first user.

By if the received signal ( $1+2+3+...+M$ ) passes through data correlator (10), the de-spreading process being passed through and passing through the quantizer (20) it is quantized and it is decoded.

If the decoded signal as described above is inputted to the refreshable (30), when looking at in the position of the first user signal, it regenerates to the signal of the despreading previous in a refreshable only the first signal which is its own signal.

That is, it restores to the signal of the decipher former.

So, in the second user, the signal of the regenerated first user as described above enters in the signal restoration to M number user to the interference canceller and it sucks in the transmitted received signal input.

Because, in the second user, the signal of the first user removes in the signal (2,3,4, ...,M) position to M number user in the interference canceller since acting on an interference.

Moreover, when seeing in the signal restoration position of the first user, a signal to M number from the regenerated second by the other users, that is,  $2+3+...+M$  signals is looked at in the received signal input ( $1+2+3+...+M$ ) originally transmitted from the interference canceller (40) from the transmission group as an interference and it removes.

Next, it looks into in the position of the received signal of the second user.

By if the reception input signal ( $1+2+3+...+M$ ) passes through data correlator (10), the de-spreading process being passed through and passing through the quantizer (20) it is quantized and it is decoded.

If the decoded signal as described above is inputted to the refreshable (30), when looking at in the position of the second user signal, it regenerates to the signal of the despreading previous in a refreshable only the second signal which is its own signal.

That is, it restores to the signal of the decipher former.

So, in the first user, the signal of the second regenerated user as described above enters in the signal restoration to M number user to the interference canceller and it sucks in the transmitted received signal input.

Because, in the first user, the signal of the second user removes in the signal (1,3,4, ...,M) position to M number user in the interference canceller since acting on an interference.

Moreover, when seeing in the signal restoration position of the second user, a signal to M number from the regenerated first by the other users, that is,  $1+3+...+M$  signals is looked at in the received signal input ( $1+2+3+...+M$ ) originally transmitted from the interference canceller (40) from the transmission group as an interference and it removes.

And finally, it looks into in the position of the received signal of M number user.

By if the reception input signal ( $1+2+3+...+M$ ) passes through data correlator (10), the de-spreading process being passed through and passing through the quantizer (20) it is quantized and it is decoded.

If the decoded signal as described above is inputted to the refreshable (30), when looking at in the position of M number user signal, it regenerates to the signal of the despreading previous in a refreshable only M number signal which is its own signal.

That is, it restores to the signal of the decipher former.

So, in the first user, the signal of the regenerated M number user as described above enters in the signal restoration to (M-1) \*\*\* user to the interference canceller and it sucks in the transmitted received signal input.

Because, in the first user, the signal of M number user removes in the signal (1,2,3, .., (M-1)) position to (M-1) \*\*\* user in the interference canceller since acting on an interference.

Moreover, when seeing in the signal restoration position of M number user, a signal to (M-1) \*\*\* from the regenerated first by the other users, that is,  $1+2+...+(M-1)$  signals is looked at in the received signal input ( $1+2+3+...+M$ ) originally transmitted from the interference canceller (40) from the transmission group as an interference and it removes.

Even if in case of being ideal, the signal passing through the interference canceller (40) to this kind of mode remains only the signal of the user for to restoring but the signal passes through the interference canceller since a receiver is unable to be in fact ideal, the signal of the other users to some extent remains.

Therefore, it is the form of the multi level structure of going over to the step that the output of the interference canceller (40) is again inputted to data correlator (10) attended by the drunken fellow.

In other words, the part consisting of data correlator (10), the quantizer (20), the refreshable (30) and interference canceller (40) is 1 shift. 2 shift is initiated while the output of the interference canceller is inputted to data correlator of the next stage.

And it suggests in the present invention that the signal passing through the interference canceller of the final stage after the process described in the above enters the input of the channel estimator.

In this way, since the signal passing through the interference canceller is inputted to the channel estimator (50) the channel estimation error is reduced, the exact channel estimate can be obtained.

And since the channel estimate of the channel estimator (50) again repeats data correlator and the process of being inputted to a refreshable and again passing through the decode procedure from 1 shift described in the above to M shift of the multi-stage receiver the reliability can be enhanced against the received signal reconstitution of the whole receiver.

As described above, in the present invention, by operating the channel estimator by using the signal removing an interference by the other users in the sequential CDMA receiver in which a plurality of users exists and using the multi-stage parallel interference canceller the channel estimation error is minimized and the performance of the whole receiver can be improved.

#### ■ Effects of the Invention

As shown in the above, as to the channel estimator for using the parallel interference canceller, in order to since by increase the capacity of a user and improve the performance of a system, a user uses the signal which is interference removed in case the multi-stage parallel interference canceller is used and it estimates a channel it improves the performance of the channel estimator, using the exact channel estimate and restoring the received signal it can improve the performance of a receiver.



#### Scope of Claims

##### Claim 1 :

The channel estimator for using the parallel interference canceller of the CDMA receiver comprising the channel estimator signing the interference canceller removing the interference signal and the signal which is interference removed from the interference canceller to an input and estimates a channel.

##### Claim 2 :

The channel estimator using the parallel interference canceller of the CDMA receiver comprising the channel estimator which is comprised of data correlator despreaded for the reconstitution of data, the quantizer quantizing the signal, the refreshable roofing tile regenerating the received signal, and the interference canceller removing the regenerated signal by the other user from the received signal is a multi-stage; and the signal in which an interference is removed among a multi-stage from the

interference canceller of the final stage from the received signal is input and estimates a channel, and the quantizer quantizing the signal is despread through data correlator.



Drawings

Fig. 1

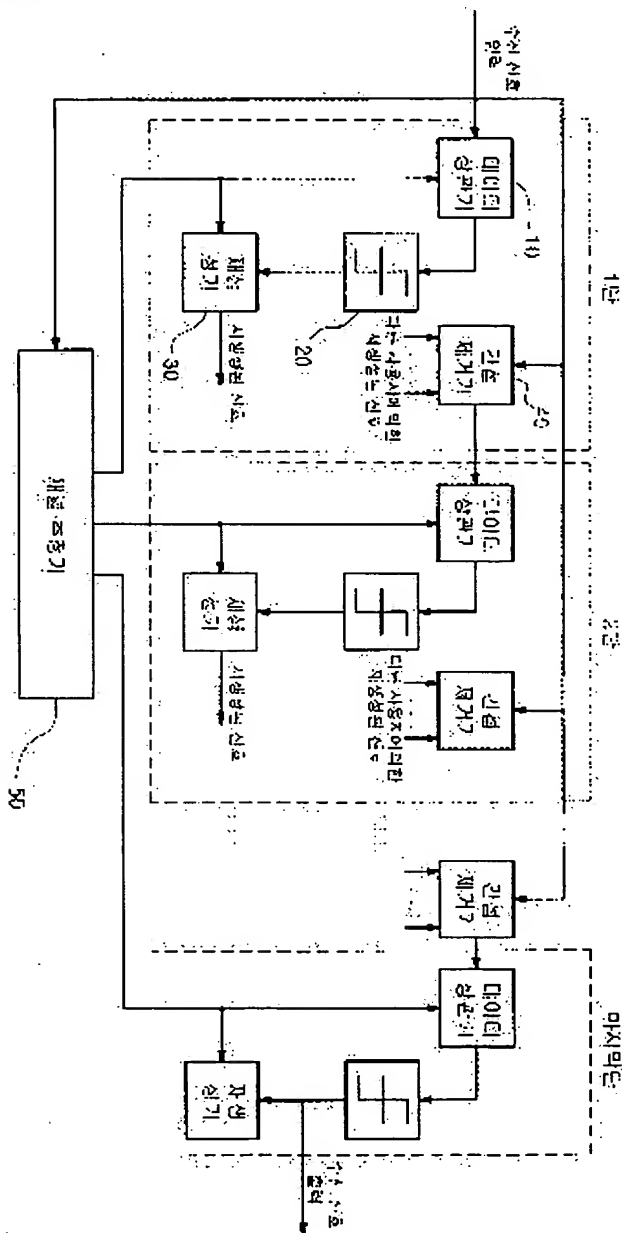
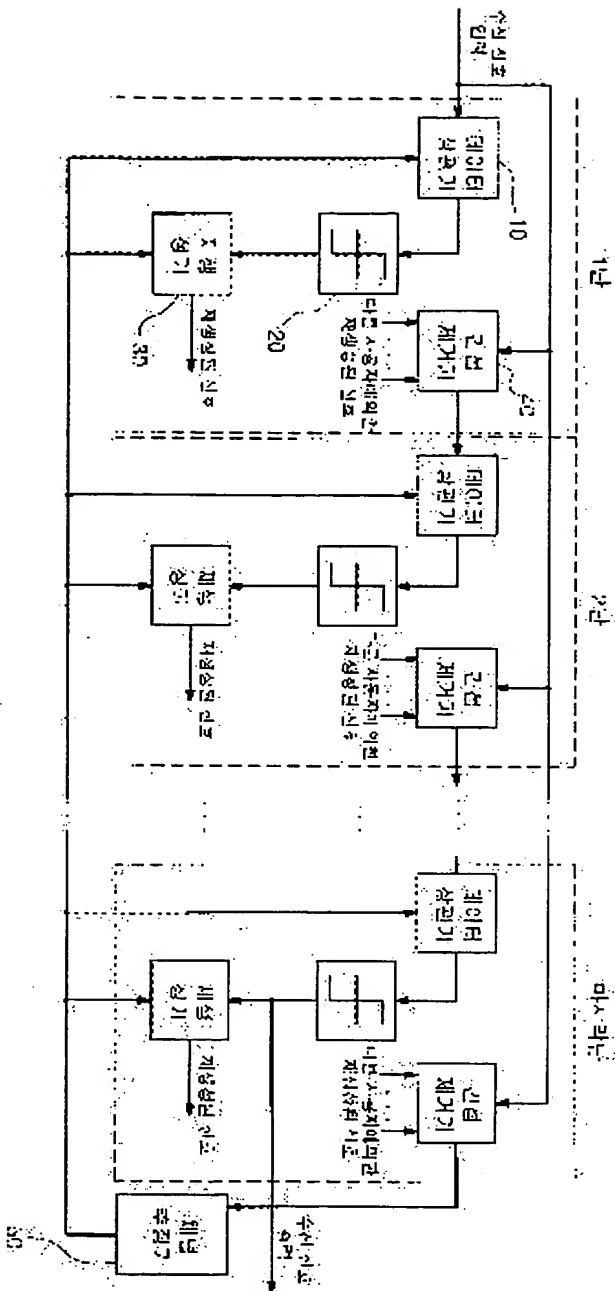


Fig. 2

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